Observational study of aerosol–cloud over Northern China

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After more than 30 years of fast economic growth, China have to cope with increasing air pollution, of which aerosol is the main pollutant. At present, air pollution and its impact on climate have been paid much attention in the community of atmospheric sciences. The key point of understanding the relationship between atmospheric environment and climate change is to understand the mechanism of aerosol-cloud interaction, and its intensity and extent. This is very significant to improve the present knowledge of the climate change. A state-of-the-art aerosol-CCN observational system, including the SMPS for measuring the aerosol size distribution, a CCN counter for measuring the number density of CCN, a multi-wavelength lidar for detecting the aerosol size distribution near cloud bottom altitude, and a quasi-open chamber for studying the aging process of aerosols were established. With help of these state-of-the-art instruments, the genesis, growth and aging processes of aerosols were investigated, relationship between CCN and aerosol were parameterized, and the CCN number density was retrieved from the measurements of a multi-wavelength lidar, in order to understand the transformation from aerosols to CCN under complex air pollution, and provide an parameterization scheme of aerosol size distribution and calculating CCN number density, which is well fit to the typical region of China. This parameterization is applicable to improve the GCMs and the assessment of the impacts of air pollution on climate.

The intensive experiments were carried out in Xianghe, Hebei Province, in the summer of 2013, and in Xinzhou, Shanxi Province in the summer of 2014. The observation of CCN number density, aerosol size distribution, activation ratio, hygroscopic growth, mix-state, and aerosol optical property, chemical composition, vertical structure, liquid water content were conducted. It is found that the genesis of new particles greatly affects the aerosol activation ratio. During the early stage of genesis of aerosol particles, CCN number density doesn't increase a lot, while during the new particle growth and mature periods, it increases a lot. It is also found that the chemical compositions in Xianghe and Xinzhou are quite different. The major compositions of PM_1 are sulfuric salt in Xinzhou, while organic compunds and nitrates in Xinaghe.

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